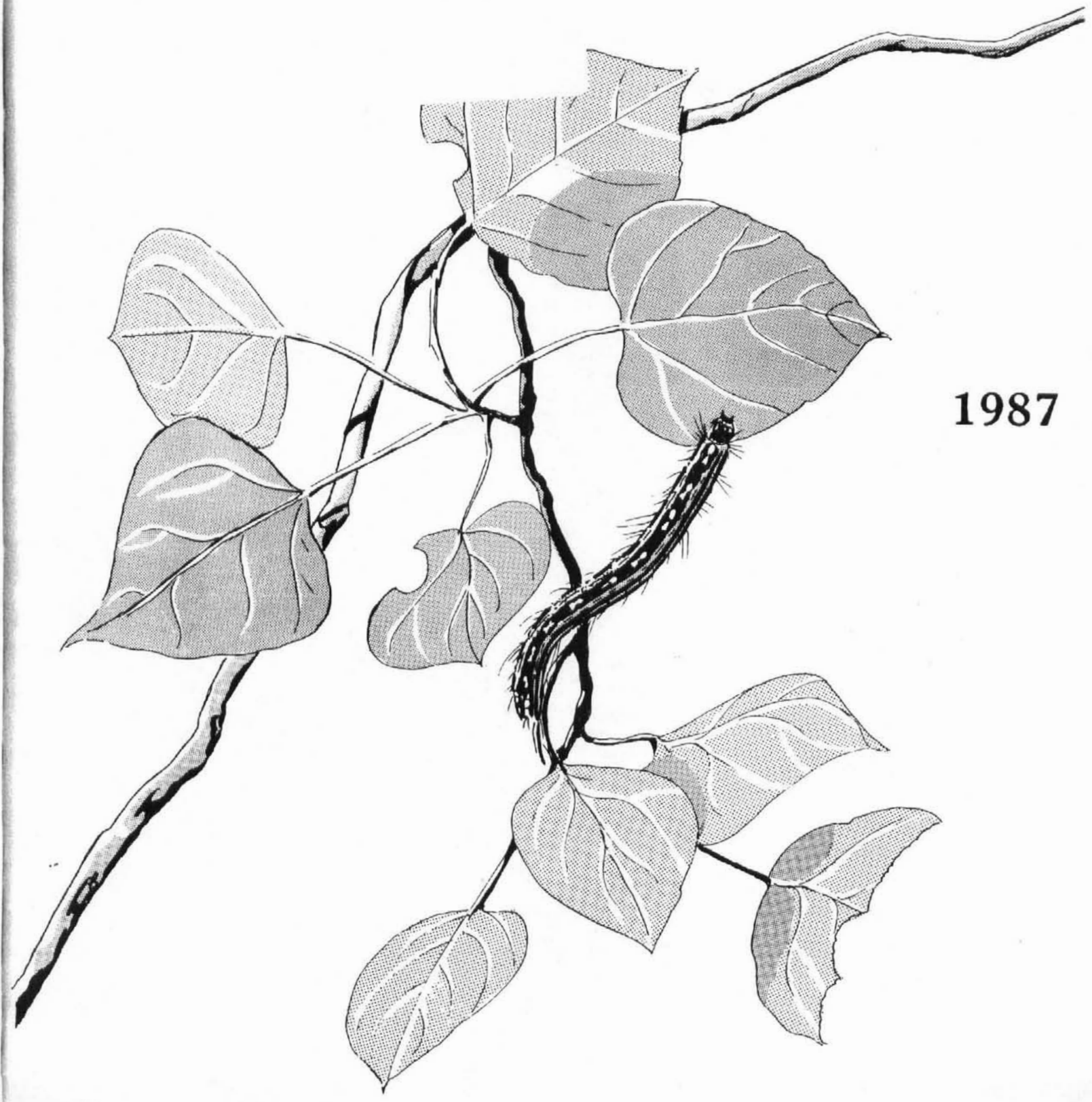
Forest Insect and Disease Report

Bob

Brainerd Region (1)



1987

Minnesota Department of Natural Resources, Division of Forestry

1987 FOREST PEST REPORT

BY

The Forest Insect and Disease Unit

Minnesota Department of Natural Resources

Division of Forestry

April, 1988

St. Paul, Minnesota

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MINNESOTA FOREST INSECT AND DISEASE MANAGEMENT PROGRAM

There are approximately 16.5 million acres of forest land within the State of Minnesota. Over one-half of the commercial forest land within the state is publicly owned. These forests support a 2 billion dollar forest industry, which is the third largest industry within the state. The Minnesota Department of Natural Resources (MN-DNR) has been charged by the legislature with management efforts and/or support on Minnesota's state, county, and private forest lands.

Minesota's Forest Insect and Disease Management Unit is contained within the Forest Management Section of the MN-DNR Forestry Division. Field activities within this division have been regionalized into six regional administrative units. The insect and disease unit consists of a Forest Insect and Disease Supervisor, one statewide Pesticide Use Coordinator, four regional Forest Insect and Disease Specialists, and three seasonal Plant Health Specialists. The four Specialists and the three Seasonal Specialists have regional responsibilities.

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PEST CONDITIONS REPORT: INSECTS

JACK PINE BUDWORM
Choristoneura pinus Freeman

ACREAGE: 80,600

SEVERITY:

DEFOLIATION	
Light (1-20% needle loss):	40,960
Moderate (21-50% needle loss):	17,300
Heavy (>50% needle loss):	22,400

RECENT HISTORY: Prior to 1984, budworm activity was limited to 2,800 acres in the Virginia area in St. Louis County in northeastern Minnesota. In 1984 budworm activity exploded and was detected on 210,000 acres, statewide. Populations remained high statewide in 1985 but began to decline in northeastern Minnesota in 1986. In 1986 budworm activity moved northwestward into the jack pine areas close to the Canadian border, north of Red Lake.

PREDICTIONS: Budworm populations are expected to decline in all 3 northern Regions. Most activity will be found in Region 1 in northern Hubbard and southern Beltrami Counties, but these areas will experience less defoliation than in 1986 or 1987. Population numbers in Regions 2 and 3 should be low enough so that little detectable defoliation will occur. Jack pine mortality in Region 1 could start to show up during the 1988 growing season from the added stress of drought during 1987. Drought conditions are likely to continue into 1988.

REGIONAL NOTES

Region 1: In 1985, heavy feeding occurred in southern Hubbard, Crow Wing, and Wadena Counties. In 1986 and 1987, defoliation moved northward in Hubbard County into Beltrami County while declining in 1986 in Crow Wing County and in Wadena County in 1987. In 1986 there was an area of moderate defoliation in Roseau County in northwestern Minnesota, but it was only very lightly defoliated in 1987.

The mild winter of 1986-87 led to an early spring and early budworm activity. On May 18th, a University of Minnesota graduate student collected 2nd instar budworm larvae in staminate cone clusters in Hubbard County. During the last week in May, third and fourth instar larvae were found feeding in a red pine Christmas tree plantation in northern Wadena County, and by the first of June some 6th instar larvae could be found. Third instar larvae were found in Roseau County on June 2nd. Jack pine reddening could be seen in Hubbard County as early as the week of June 15th, and in a "normal" year reddening does not become evident until after the Fourth of July. Pupae were found in southern Hubbard County on June 11th.

The total acreage in Region 1 showing reddening by the end of June was 80,500 acres and acreages are summarized in Table 1.

TABLE 1: 1987 JACK PINE BUDWORM DEFOLIATION BY COUNTY AND SEVERITY.

COUNTY	1-20%(L)	21-50%(M)	>50%(H)	TOTALS
Hubbard	23.200	7.500	11.700	42.400
Beltrami	12.200	5.900	8.800	26.900
Becker	5.400	3.900	1.900	11.200
TOTALS	40.800	17.300	22.400	80.500

The total defoliated area was reduced from that experienced during 1986. In 1986, 113,400 acres were defoliated, but in 1987 defoliation amounted to only 80,500 acres. Moderate to heavy defoliation categories in 1986 accounted for 68,000 acres or 60% of the total area defoliated, but in 1987 defoliation in these categories accounted for only 39,700 or 49% (see Table 2).

TABLE 2: 1986 AND 1987 JACK PINE BUDWORM DEFOLIATION COMPARISONS BY SEVERITY CATEGORIES

1-20%(LIGHT)		21-50%(MODERATE)		>50%(HEAVY)	
1986	1987	1986	1987	1986	1987
45,400	40,800	41,800	17,300	26,200	22400

Hubbard County again had the greatest acreage defoliated, and this was the second year of major defoliation in this county as well as in Becker and Beltrami Counties (see Table 3). The biggest change occurred in Roseau County where some larval feeding was detected, but no significant defoliation occurred. The Region 1 portion of Cass County had significant defoliation in 1986, but defoliation could not be detected in the northeastern corner of Cass County during 1987.

TABLE 3: 1986 AND 1987 JACK PINE BUDWORM DEFOLIATION COMPARISONS BY COUNTIES

COUNTY	TOTAL DEFOLIATION	
	1986	1987
BECKER	15,700	11,200
BELTRAMI	32,700	26,900
CASS	5,400	0
HUBBARD	52,000	42,400
ROSEAU	7,600	0
TOTALS	113,400	80,500

Egg mass surveys were not conducted during 1987; so, predictions based on egg mass survey results cannot be made. This infestation, however, seems to be following a similar pattern to the 1970's infestation: the first year an area will experience light defoliation, the second year the same area will experience moderate to heavy defoliation, the third year the area will experience very light defoliation, and the fourth year there will be no defoliation. If this pattern is followed, only light to very light defoliation will occur in the major jack pine areas south of Red Lake.

The jack pine areas north of Red Lake seem to experience one year of moderate to heavy defoliation and then the budworm disappears. If this is the case, budworm could defoliate some areas in Roseau and Lake of the Woods Counties where budworm has not been found. During the 1976-77 infestation, moderate to heavy defoliation occurred to an area in Roseau County during 1976, but the population totally disappeared in 1977 without moving into new areas. In 1986, moderate defoliation once again occurred in a small area in Roseau County, but in 1987 no jack pine defoliation occurred even though feeding larvae could be found. If predictions are based on this pattern from these infestations, little defoliation should be evident in these two counties in 1988.

Region 2: A major population collapse began in 1986 and continued in 1987 leaving a few remnants in Region 2. Budworm activity, however, may intensify in the Dentaybow area in Koochiching Co.,in the Echo Trail area in St. Louis Co., and southwest of Lake Winnibigoshish in Cass Co.

Extremely light budworm activity was noted or reported in all the counties in Region 2. No defoliation was detected during the aerial survey; however, 100 acres of defoliation were detected from the ground in Cass Co. Populations moved eastward from the 1986 outbreak in Region 1, and apparently the infestation is now located along the southwest shore of Lake Winnibigoshish in Cass Co.

Lifestage and defoliation surveys were conducted by Station personnel on 12 permanent plots. In two locations, single early instar larvae were found during the survey. Pheromone trap catches ranged from 0-8 moths with the Echo Trail area in St. Louis Co. having the highest catch. (See survey results in the Appendix.)

Jack pine stands near the Lake One access in northwest Lake Co. are representative of the effects of budworm defoliation in the northern part of the Region. In 1986, the jack pines started recovery by producing a few shoots and needles on the crowns that showed some topkill. This year the jack pines continued their recovery by filling out more of their crowns.

Phenological notes

April 26: Expanding shoots are 2-3"long: Itasca Co.
May 1: Cones visible; no pollen shed: Itasca Co.
June 2: Single 3rd instar larva found on wolf tree: St. Louis Co. T62-R12.
June 9: One small 4th instar larva found: St. Louis Co. S14-T60-R20.

REGION 3: Budworm populations continued to decline in this Region. Activity was noted in a 3 meter tall dog-haired stand of jack pine in northwestern Cass County. The stand was so thick that the trees initiated heavy staminate flower production which created favorable conditions for budworm survival.

Feeding was also observed in a 20 acre red pine Christmas tree plantation in northern Wadena County. The plantation was surrounded by large jack pine which was

serving as the source for the infestation. The landowner had sprayed the plantation in 1986 with Orthene, but he had sprayed late, after damage had already taken place. The landowner sprayed Orthene again in 1987, but heavy rains followed the spraying and little control was attained. However, damage was very light.

Nine trapping locations each with three pheromone traps were established throughout the Region. (See survey results in the Appendix). Moth catches ranged from a total of 1 at the Willow River State Nursery in Pine County to a total of 487 in 15-138-32 of Cass County. The defoliation at each trapping location was rated as "light" except at the Cass County site where it was rated as "moderate." Egg mass surveys at each of the trapping locations found only one egg mass and that was near Willow River, SESW 36-45-20 in Pine County. Based on these surveys, predictions for defoliation in Region 3 during 1988 are for light to very light defoliation in all of the major jack pine areas.

PINE TUSSOCK MOTH
Dasychira plagiata Dyer

ACREAGE: 60

SEVERITY: Defoliation
Light (1-20% needle loss): 60

RECENT HISTORY: Severe outbreaks have occurred in Pine County in which major jack pine mortality has occurred, and large scale aerial spraying has taken place. Tussock moth activity has been at a low level since the late 70's. In 1985 life stage surveys detected a building population, but in 1986 only 1 larva and no egg masses were found at the checkpoints.

PREDICTION: Activity should be very light in 1988 with any defoliation being in the very light to light categories.

Regional Notes

REGION 3: This is the only Region which regularly monitors the tussock moth since tussock moth activity in the past has caused heavy damage in Mission Township in Crow

Wing County and around the General Andrews Nursery in Pine County. The monitoring program consists of pheromone traps, larval surveys, and egg mass surveys.

In 1986 only one larva was observed during the larval survey region-wide. In 1987 no caterpillars were found. No egg masses were found in either 1986 or 1987. Ten pheromone traps were set out and a total of 413 moths were caught (see survey results in the Appendix). The higher moth catches and the 60 acres of light defoliation do indicate an upswing in tussock moth activity. However, little additional defoliation is expected.

BARK BEETLES
Ips spp.

ACREAGE: Actual acreage has not been determined since bark beetle activity occurred in variable-sized pockets; however, in Region 3, alone, there were at least 250 bark beetle pockets identified.

SEVERITY: Each pocket of bark beetle activity contained bark beetle killed trees. The pockets ranged in size from 10 to 150 dead trees.

RECENT HISTORY: Serious bark beetle outbreaks are associated with drought conditions. The last serious bark beetle outbreak occurred during the drought of 1980. Drought conditions began developing during the winter of 1987; little snowfall accumulation occurred, and an early and dry spring followed. Before 1987, above normal precipitation characterized 1985 and 1986. High water tables, particularly around potholes stressed and killed trees and these trees served as brood trees contributing to high populations of bark beetles which then attacked nearby drought-stressed trees later in the growing season.

PREDICTIONS: Bark beetle activity is expected to increase during 1988 due to the continuation of drought conditions in the affected area and the large bark beetle population built up during 1987. If the

spring has normal or below normal precipitation, there is a strong possibility that old bark beetle pockets will expand and new pockets will be found. Only a wet spring will help lessen the risk.

Regional Notes

Region 1: Bark beetle activity was noted in Hubbard and Lake of the Woods Counties. In both counties, pine mortality was associated with high water conditions around potholes where water-stressed trees were killed by bark beetles.

Region 2: The droughty spring weather stressed pines in this Region and predisposed them to bark beetle attack. Successful attacks were observed in pine stands that were thinned or cut between early spring and late summer, in stands struck by lightning, or affected by other damaging agents.

It is suspected that a large number of bark beetle pockets were initiated in 1987. Bark beetle-caused mortality was reported in S36-T155-R25, S6-T64-R19, and S32-T55-R13. On the last site, a single lightning-struck red pine served as a brood tree. By June 22nd, 150 red pines (60' tall) surrounding the brood tree were also dead and infested with bark beetles. Salvage operations began on June 23rd.

Region 3: Both red pine and jack pine areas in Pine, Aitkin, Kanabec, Mille Lacs, Wadena, Morrison, Isanti, Chisago, Sherburne, and Benton Counties experienced damage from bark beetle activity. At least 250 bark beetle pockets in these counties have been found, and these pockets range from 10 to 100 trees in size. Some mortality in these areas also have been associated with high-water-killed trees in 1986.

The bark beetle situation in these counties have the long range potential to worsen regardless of weather patterns. Red pine plantations established 15 to 25 years ago at a spacing which would produce a commercial thinning at ages 20 to 30 years are going unthinned due to a lack of a pine pulpwood market. The longer these plantations are held without being thinned, the more they will stagnate, and stagnation-stress will lead to bark beetle outbreaks even with normal precipitation.

ADANA TIP MOTH
Rhyacionia adana Heinrich

ACREAGE: Documented in 4 plantations in west central St. Louis County

SEVERITY: Ranges from 1 to 62% of seedlings infested

RECENT HISTORY: Adana tip moth damaged shoots are occasionally found in young red pine plantations but generally occur at very low levels of incidence.

Regional Notes

Region 2: As shown by survey results from 4 young red pine plantations, levels of damage can become quite high with up to 62% of the trees being damaged.

Location St. Louis Co.,S-T-R	Type of stock planted	Percent seedlings currently infested	Year planted
24-60-21	container	62	1982
35-60-19	container, 2-0,3-0	10	1984
17-60-20	2-0	<1	Unknown
7-60-21	container, 2-0,2-2,3-0	<1	Unknown

Tip moth larvae damage seedlings by boring and feeding in the shoots. Trees damaged a number of years in a row may be stunted and result in a cabbage form. The damage is insignificant as long as the trees grow out of the most susceptible stage which seems to be when trees are less than 2 feet in height. However, repeated years of heavy attack in combination with other problems, such as physiological needle droop, may be significant. Physiological needle droop was found in 2 of the surveyed plantations. Evidence of past years' infestations (dead and mined shoots and old cocoons attached to stems at the soil line) was found in all 4 plantations.

Phenological notes (Adana tip moth)

April 15: R. adana have already emerged from cocoons: Side Lake, St. Louis Co.
June 2: Noted 5% seedlings attacked in ornamental planting: Tower, St. Louis Co.
July 23: Collected 1 pupa: Side Lake, St. Louis Co.

PINE SHOOT BORERS

Conophthorus resinosae Hopkins (red pine cone beetle)
Conophthorus banksiannae McPherson (jack pine tip beetle)
Dioryctria resinosella Mutuura (red pine shoot moth)
Eucosma gloriola Heinrich (eastern pine shoot borer)

ACREAGE: Shoot damage was common throughout the 3 northern Regions; however, no acreage estimate is available because occurence was scattered.

SEVERITY: When a tree was found to be infested, infested shoots were very common ranging to over 50% of the new shoots being attacked.

RECENT HISTORY: Unknown

PREDICTION: None

Regional Notes

Region 1: The heaviest damage occurred in Hubbard County, in the Park Rapids Area. Damage was confined to red pine and the majority of the damage was caused by the Eastern pine shoot borer. At the Park Rapids County Club open-grown red pine were severly damaged. Some trees had 50% or more of their new shoots attacked, and the shoots were brown and hollowed out.

Region 2: Red pine showed signs of shoot insect attacks in the vicinities of Grand Rapids and Deer River. The insect species commonly found included the red pine cone beetle and the red pine shoot moth.

Region 3: Both red and jack pine were attacked south of Brainerd. Species causing damage included the red pine cone beetle, the red pine shoot moth, and the jack pine tip beetle.

SPRUCE BUDWORM
Choristoneura fumiferana (Clemens)

ACREAGE: 430,000

SEVERITY: Defoliation (See defoliation map)
Light (1-20% needle loss): St. Louis and most of Lake Counties

Moderate to Heavy (>20% needle loss): northern Lake and all of Cook Counties.

RECENT HISTORY: In 1986, budworm caused moderate defoliation (21-50% needle loss) on 440,000 acres in Region 2. This year, defoliation intensity was mitigated by the effects of frost and the acreage was reduced slightly.

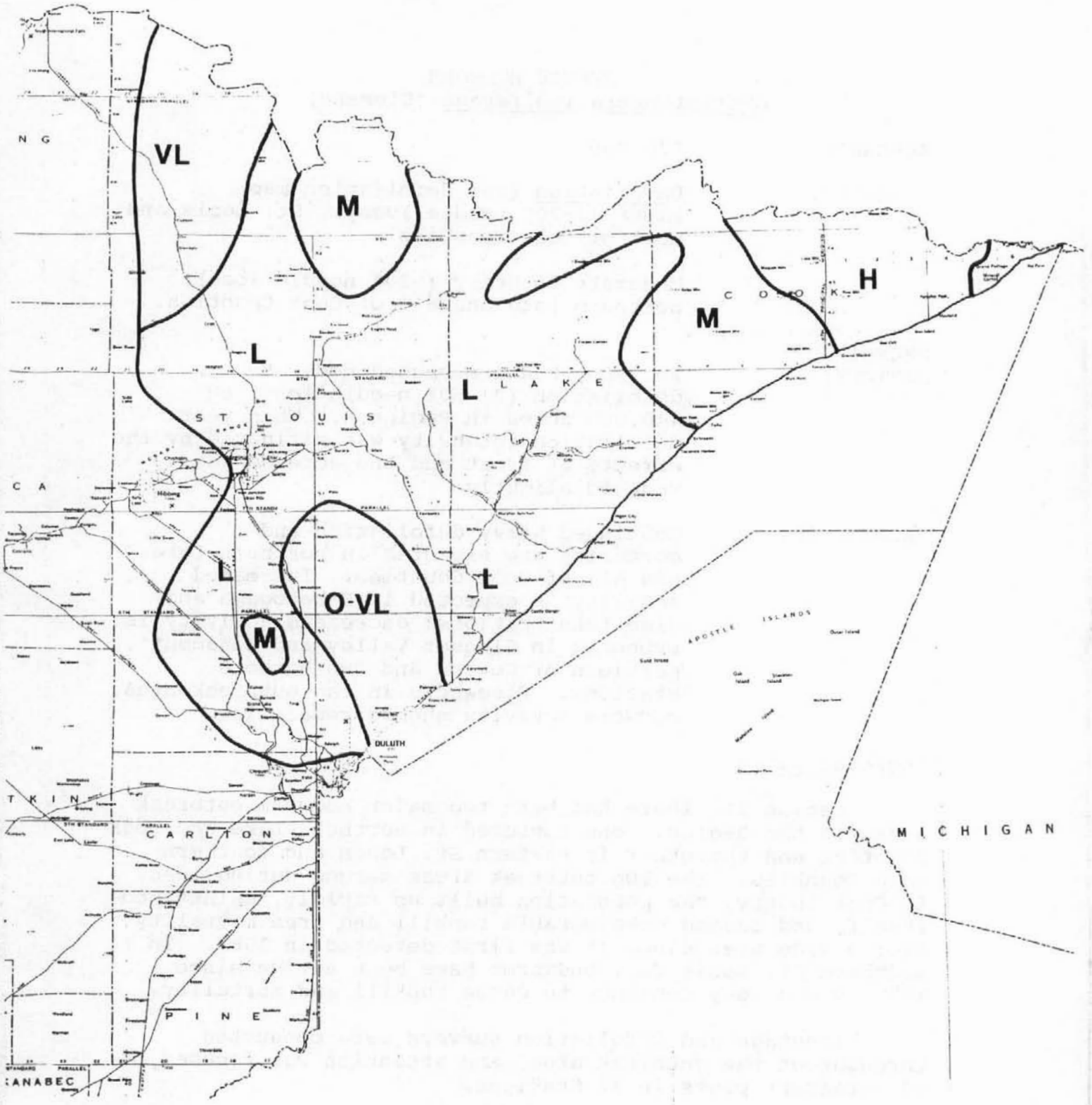
PREDICTIONS: Continued heavy defoliation and mortality are expected in northern Lake and all of Cook Counties. Increased activity is expected in Kabetogama and Side Lake Stations; decreased activity is expected in Cloquet Valley and adjacent portions of Cotton and Two Harbors Stations. Elsewhere in the outbreak area, budworm activity should remain low.

Regional Notes

Region 2: There had been two major budworm outbreak areas in the Region: one centered in northern Lake and Cook Counties and the other in eastern St. Louis and southern Lake Counties. The two outbreak areas merged during 1986. In Cook County, the population built up rapidly, maintained itself, and caused considerable topkill and tree mortality over a wide area since it was first detected in 1983. In southern St. Louis Co., budworms have been active since 1973, where they continue to cause topkill and mortality.

Lifestage and defoliation surveys were conducted throughtout the outbreak area, and attention was focused on 25 permanent plots in 12 Stations.

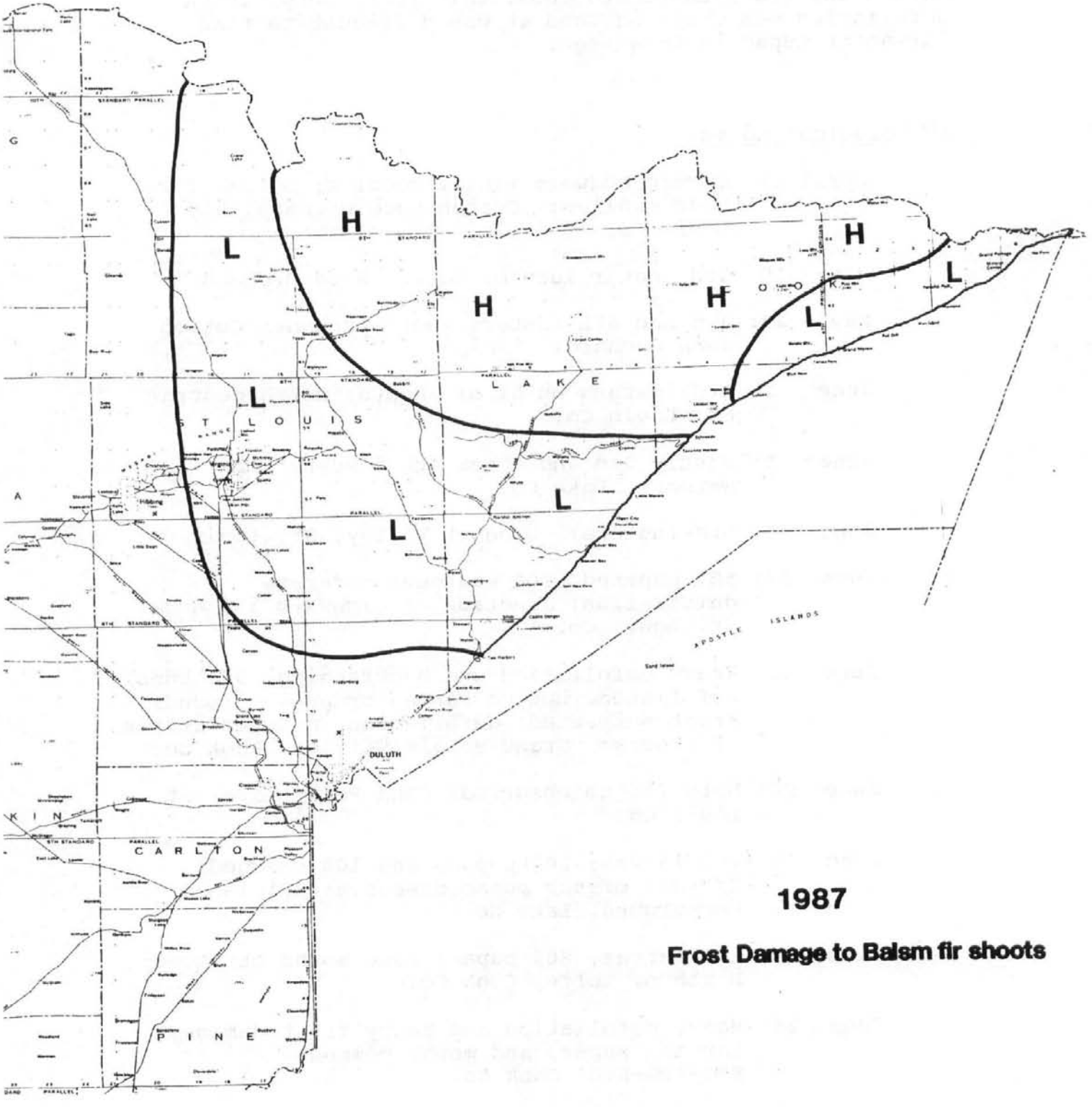
When the balsam fir shoots had elongated 1/2 to 1 inch, a hard frost killed the shoots. Most of the Region north of a line from Hibbing to Finland was affected (see map in section on Frost). This frost damage likely had an adverse effect on budworm populations since young larvae were forced to feed on and find shelter in old foliage. Frost damage also masked defoliation severity during aerial surveys; so, all severity ratings were made from ground observations.



1987

Spruce Budworm Defoliation

430,000 acres estimation



1987

Frost Damage to Balsm fir shoots

For the past three years, a declining trend has occurred in Cloquet Valley Station and adjacent portions of Cotton and Two Harbors Stations. This year, very little defoliation was observed, and it was difficult to find larvae or pupae in this area.

Phenological notes

April 29: Spruce budworm mining needles; balsam fir buds swollen: Cotton Seed Orchard, St. Louis Co.

May 15: 3rd instar larvae: Cotton Seed Orchard

May 29: 3rd and 4th instars; not abundant: Cotton Seed Orchard

June 2: 3rd instars on 5% of shoots: north central St. Louis Co.

June 5: Mostly 3rd and a few 4th instars: Two Harbors, Lake Co.

June 10: 5th instars: Cloquet Valley, St. Louis Co.

June 17: 85% pupated, 10% emerged; moderate defoliation: Junction of highways 133 and 7, St. Louis Co.

June 18: Heavy defoliation and backfeeding; 95% buds defoliated, but no larvae or pupae found; frost suspected; defoliation in upper 2/3rds of crowns: Grand Marais Station, Cook Co.

June 20: Moth flight observed: Sand Point Lake, St. Louis Co.

June 25: 40% larvae, 50% pupae, and 10% emerged; 2/3rds of the pupae diseased: Finland Campground, Lake Co.

June 25: 20% larvae, 80% pupae; some moths observed: North of Tofte, Cook Co.

June 26: Heavy defoliation and heavy frost damage; larvae, pupae, and moths common: S33-T63-R4E, Cook Co.

June 29: Late instars, pupae, and moths found: Fernberg Trail, Lake Co.

YELLOW-HEADED SPRUCE SAWFLY
Pikonema alaskensis (Rohwer)

ACREAGE: Not determined

SEVERITY: Very light

RECENT HISTORY: Very low levels.

PREDICTION: None

Regional Notes

Region 2: Populations are still at very low levels throughout the Region. The only location where damaging populations were observed was north of Two Harbors in southern Lake County. Sawflies were causing heavy defoliation to an ornamental planting of white spruce. The trees were 6-10 feet in height.

Phenological notes

June 5: Adult sawflies noted; lilacs in bloom: Two Harbors, Lake Co.

BALSAM TWIG APHID
Mindarus abietinus (Koch)

ACREAGE: Not determined.

SEVERITY: Light

RECENT HISTORY: Not observed in any abundance in the last few years.

PREDICTIONS: None

Regional Notes

Region 2: Aphids were very abundant in locations throughout St. Louis Co. In some stands, 80% or more of the current shoots of sapling-sized trees were infested. On the average tree, approximately 20% of the new shoots were infested. Damage from the aphids is usually not serious but they do cause needles to curl and deformation of current year shoots. One Christmas tree grower in northern St. Louis Co. treated his trees due to a high aphid infestation.

LARCH SAWFLY
Pristiophora erichsonii (Hartig)

ACREAGE: 50

SEVERITY: Defoliation
Light: <20% needle loss

RECENT HISTORY: A stand in central St. Louis County has been defoliated for the past few years. In 1986, defoliation was heavy with greater than 50% needle loss.

PREDICTIONS: None

Regional Notes

Region 2: Larch sawfly caused light defoliation in S32-T58-R16 and S5-T57-R16 in central St. Louis Co. Larch sawfly has been defoliating tamarack on this 50 acre site for the past couple of years. Defoliation was heavy in 1986 but decreased to light this year.

Larvae were collected by Dr. Herbert Kulman, Univ. of Minnesota-Entomology, in order to raise insects parasitic on sawflies.

GYPSY MOTH
Lymantria dispar (Linnaeus)

ACREAGE: 40

SEVERITY: Isolated infestations occurred with no observable defoliation.

RECENT HISTORY: Isolated infestations from recent and past introductions continue to be found. However, the number of separate trap sites recovering male moths continues to decline.

PREDICTIONS: No outbreaks or major defoliation are predicted. Small numbers of male moths will continue to be recovered from new and existing introductions. The rate of new introductions will remain the same given the collapse of the general infestation in the eastern United States, but this will be balanced by increased introductions from Michigan. This trend will continue for the next several years but will eventually reverse. Within fifteen years, infestation of Minnesota by gypsy moth could occur as the moth continues its current spread throughout Michigan and Wisconsin.

Statewide Monitoring Program

Statewide cooperative efforts between the Minnesota Department of Agriculture and the Department of Natural Resources resulted in the placement in 76 counties of 6,777 pheromone traps the purposes of detection, delineation, and control. The Department of Natural Resources placed 550 of these traps statewide on public lands in high recreation use areas. There were no male gypsy moths found in traps placed and monitored by DNR-Division of Forestry personnel; however, in Department of Agriculture traps, 322 moths were recovered at six locations. Division of Forestry trapping will increase by about 50% in 1988.

Trap catches and locations are as follows:

COUNTY	LOCATION	# MOTHS
Anoka	Oak Grove	304
Dakota	Eagan	1
Hennepin	Lake Rebecca	1
Hennepin	Minnetonka	3
Sherburne	Elk River	1
Wright	Delano	12

Regional Notes

Region 1: One hundred forty traps were placed throughout the Region. In 1986, a single male moth was caught in a campground in Itasca State Park in Clearwater County. In 1987, 20 traps were concentrated around the trap catch area. No additional moths were trapped. The 1986 trap catch probably represented a single hitchhiking moth.

Region 2: One hundred forty-eight traps were placed throughout this Region, and all traps were negative for gypsy moth.

Region 3: There was a 1-acre core infested area found in Wright County. Twelve moths were trapped and 9 old egg masses were found on a camper brought in from New Jersey in 1986. Eradication treatments are planned for this area during 1988 using Bt, Dimilin, or Sevin. Mass trapping of the area will follow the eradication treatment.

Region 5: A 10-acre infestation was found in Anoka County. It is probable that this infestation was brought into Minnesota by a family moving in from the eastern part of the United States during 1980. It expanded to its current size and was discovered by the landowner. Gypsy moth survival for 7 years further shows that gypsy moth can survive Minnesota's winters. Eradication treatments will also be undertaken in 1988 using Bt, Dimilan, or Sevin.

Three hundred and four moths were trapped, but in addition to these, 284 larvae were removed from burlap band larval traps in mid to late June. An egg mass survey conducted on August 21 located 44 viable egg masses which have been collected by University of Minnesota personnel for parasite rearing. Eradication treatments followed by mass trapping will be carried out during 1988.

Single male moths continue to be caught in the area of Minnetonka indicating a possible infestation in this area.

1987 Aspen Defoliators ●

Forest Tent Caterpillar 168,000 acres

■ M-H Very light to Light defoliation and or caterpillars present in scattered locations in St. Louis, Carlton and southern Lake Co.

Large Aspen Tortrix 200,000 acres

▨ M-H

▨ Scattered and Light

● Other caterpillars (aspen tiers, leaf rollers, etc.) present with FTC and / or LAT

FOREST TENT CATERPILLAR
Malacosoma disstria Hubner

ACREAGE: 178,000

SEVERITY: Defoliation
Moderate to Heavy (>20% defoliation)

RECENT HISTORY: Increasing populations are occurring in all forest tent caterpillar outbreak areas, statewide. There was a 3-fold increase in defoliated acreage compared to 1986.

PREDICTIONS: In the absence of a significant late spring frost, defoliation of hardwood stands in central and southern Minnesota will continue to occur within the 1987 outbreak areas. Across the northern part of the state, the populations seem to be in the building and expanding phase of their cycles, which means that the populations will expand into surrounding areas previously free of forest tent caterpillar activity.

Regional Notes

Region 1: FTC activity was reported causing some noticeable defoliation in Maplewood State Park in Ottertail County. At the same time cankerworm defoliation reports were received from the same area. Because neither situation could be checked during defoliation, it is unknown whether or not the defoliation was caused by FTC or cankerworms. Both defoliators have been active in the past, and efforts will be made to investigate the area during 1988.

Reports were received of minor forest tent caterpillar activity in the Itasca County portion of the Northome Field Station area and from Itasca State Park.

Region 2: Forest tent caterpillars were reported from scattered locations throughout Region 2. They were reported in Itasca, St. Louis, Lake, Cook and Carlton Counties. Most of the reports were of low population levels with little observable defoliation. However, in southern St. Louis Co. and northeastern Carlton Co., moderate to heavy defoliation occurred on 168,000 acres. The moderate and heavy defoliation centered around the Brookston area in St. Louis Co. which has been defoliated every year for more than 10 years.

A mixture of defoliators were active along with the forest tent caterpillars. They included aspen leaf rollers, leaf tiers, and large aspen tortrix.

Pupal parasitism was assessed at 3 locations near the Brookston area in southern St. Louis Co. At least 100 cocoons were collected at each location for the survey. The average parasitism was 59% which is down from the average of 81% in 1986.

Phenological notes

April 6: Aspen catkins blooming.

April 18: Aspen leafout: Itasca Co. First instar larvae emerge from eggmasses collected on April 16 at Brookston, St. Louis County.

April 29: Only 50% of aspen clones have broken bud.

May 15: Larvae range from 1 1/4 to 2" long: Hwy 7 north of Brookston, St. Louis Co.

June 5: Pupation noted in S33-T51-R15; mostly 4th and 5th instars; some with viral disease; Sarcophagid flies present: St. Louis Co.

June 17: 70-80% pupated: Independence, St. Louis Co.

June 19: 95% pupated: Cotton, St. Louis Co.

June 20: Moth flight observed: Sand Point Lake, northern St. Louis Co.

June 29: Pupae present: S23-T52-R16, St. Louis Co. Moth flight: Independence, St Louis Co.

Region 4: Ten thousand acres were defoliated in this region in 1987. Eight thousand acres were located in Kandiyohi County, and 2,000 acreas were found in Lyon County.

The infestation is established in a diverse hardwood forest and has varied greatly over its eight to ten year history. In 1986, fewer than 500 acres of defoliation were detected in these areas. In 1987, the mild spring conditions and the lack of a late spring frost were ideal for expanding populations. However, starvation was likely in much of the heavily defoliated areas, a virus disease was observed, and the Sarcophagid fly parasite was active.

LARGE ASPEN TORTRIX
Choristoneura conflictana (Walker)

ACREAGE: 250,000

SEVERITY: Defoliation
Light (< 20% leaf loss): 200,000 acres, NE Minnesota
Moderate (20-50% leaf loss): 50,000 acres, NW Minnesota

RECENT HISTORY: The outbreak began in 1984 and has intensified and spread over most of Cook County and into east Lake Co. A new infestation began in the northwest in 1986 and became more evident in 1987.

PREDICTIONS: A decrease in severity and acreage is likely in the northeast while continuing defoliation is likely in the northwest.

Regional Notes

Region 1: Tortrix caused noticeable thinning of aspen crowns in northwestern Beltrami County and throughout Roseau County. By June 2nd some trees showed upto 80% rolled leaves in the top third of their crowns. This is the second year for tortrix activity in this area, but this year its presence was much more obvious. Tortrix activity should continue during 1988 and will probably expand westward into Marshall and Kittson Counties.

Region 2: Although the acreage defoliated by large aspen tortrix was similar to the acreage defoliated in 1986, the severity was greatly reduced. Most of the defoliation was light and scattered in Cook and eastern Lake Counties. Only the eastern edge of Cook County suffered heavy defoliation. In some areas, such as near Grand Marais,the defoliation was so severe and early that the trees appeared not to have leafed-out in the spring. These trees did not actually have leaves until June when they refoliated. Other aspen defoliators, notably, aspen leaf rollers and leaf tiers, were causing defoliation in the same stands.

Phenological notes

April 18: Aspen leaf-out: Itasca Co.
May 29: Pupation beginning: Cotton, St. Louis Co.
June 11: Moths emerged from collections made from Bassett in Lake Co.
June 25: 75% moth emergence: Hovland, Cook Co.

ASPEN BLOTCH MINER
Phyllonorycter tremuloidiella (Braun)

ACREAGE: 3,500,000

SEVERITY: Very heavy occurrence; aspen on 1,500,000 acres had 80% and greater leaves mined by this insect.

RECENT HISTORY: This mining insect has been very common during the past decade; however, its occurrence during 1987 was heavier than any recent previous year.

PREDICTION: The aspen blotch miner should again be evident in 1988, but it is unknown whether it will equal 1987's occurrence.

BASSWOOD THRIPS
Seriocothrips tiliae Hood

ACREAGE: 100,000

SEVERITY: Light defoliation (<20% leaf loss)

RECENT HISTORY: Basswood thrips were first reported in 1983, but their occurrence has been ongoing for at least 7 to 8 years. They have been found in northeastern Minnesota where tree mortality has occurred, and they have been very common in southeastern Minnesota. The infestation in southeastern Minnesota seems to be decreasing in occurrence and activity.

PREDICTIONS: Continued light activity is expected throughout these historic thrips' areas.

Regional Notes

Region 2: Basswood thrips were first found in Carlton County in 1983. The infestation had evidently been present some time prior to 1983 as evidenced by the presence of tree mortality. Thrips have also been reported in at least 3 other locations in St. Louis Co.: near the junction of highways 7 and 33, near Spirit Mountain by Duluth, and near Midway by Eveleth.

Thrips were observed damaging trees in only 2 locations in Region 2. The damage at the 2 locations in Carlton Co., S23-T48-R16 and S21-T49-R18, was less severe than in 1986. The stand in S23 suffered more damage than the one in S21. Some leaf shredding and blackening were observed, but overall the defoliation was light to very light. Branch and tree mortality from previous years' damage were evident at both locations.

Region 5: The current infestation is now 7 to 8 years old. It is likely that very soon throughout this region the infestation will subside to barely detectable levels. This has been the experience of eastern Ontario during infestations in the 1960's and 70's.

BIRCH LEAFMINER
Fenusa pusilla (Lepeletier)

ACREAGE: Not determined

SEVERITY: Heavy (>50% of crowns infested)

RECENT HISTORY: At endemic levels in the forest.

PREDICTION: None

Regional Notes

Region 2: Birch leaf miner activity was extrememly high in all counties in Region 2. During the aerial survey in early July, many of the birch along the North Shore of Lake Superior were completely tan. This is much heavier than normal and may be due to a combination of birch leaf miner and the drought in the spring and early summer of 1987.

ELM LEAFMINER
Fenusa ulmi Sund.

ACREAGE: 100,000

SEVERITY: Complete defoliation

RECENT HISTORY: Chronic minor understory infestation in most years.

PREDICTIONS: Unknown

Regional Notes

Region 5: By June 15th, the infestation was present throughout the southeast hardwood forest.

OAK LACE BUG
Corythucha arcuata (Say)

ACREAGE: Not determined

SEVERITY: Moderate: 20-50% of leaves on infested trees were affected.

RECENT HISTORY: This insect is always present, but in 1987, its occurrence in Region 1 had noticeably increased.

PREDICTIONS: Unknown

Regional Notes

Region 1: This insect was very common in an area between Itasca State Park in Clearwater and Hubbard Counties to Mantrap Lake in Becker County. Feeding by this insect caused the bur oak leaves to take on a grayish brown color, and on closer inspection the undersides of the leaves were heavily encrusted with black excrement and cast nymphal skins.

OAK TWIG PRUNER
Elaphidionoides villosus (F.)

ACREAGE: Not determined

SEVERITY: Light: less than 10% of the crown areas of infested trees were affected.

RECENT HISTORY: Unknown

PREDICTION: Unknown

Regional Notes:

Region 1: Oaks in the Bemidji and Cass Lake areas were being damaged by this twig pruning insect. Twig pruners are in the same family as the long horned wood borers, and can cause serious damage to heavily attacked trees. Homeowner calls were received when ends of twigs were found laying on the ground under oak trees. The activity was so light that the presence of this insect could not be detected in the trees. The only evidence was the broken twigs on the ground.

DWARF MISTLETOE
Arceuthobium pusillum Peck

ACREAGE: 33,999 acres on state lands in Koochiching County

SEVERITY: 21% of all black spruce acres in Koochiching Co. are affected. Data from current Phase 2 Inventory.

Percent stems infested	Acres
1- 10	20,258
11- 25	8,994
26- 50	3,788
51- 80	678
81-100	269

RECENT HISTORY: In 1977, Phase 2 Inventory indicated that 17% of the black spruce was infected.

PREDICTIONS: Continued increase in severity and acres affected.

Regional Notes

Region 2: Prescribed burning was used to control dwarf mistletoe on some sites scheduled for black spruce regeneration. 299 acres were treated and the cost per acre ranged from $6.29 to $21.94. The 5-foot cutting rule, a harvest regulation that mitigates dwarf mistletoe, was used on 1625 acres.

DIPLODIA SHOOT BLIGHT
Sphaeropsis sapinea (Fr.) Dyko & Sutton

ACREAGE:	100+
SEVERITY:	Up to 25% mortality
RECENT HISTORY:	This disease exists at endemic levels throughout the pine areas in Minnesota. During the wet period of 1984-86, innoculum had built up on second year cones. When trees are stressed, wounded, and/or are under a heavy innoculum load, such as understory trees, infections can take place and be devastating.
PREDICTIONS:	Unknown, but if drought conditions continue into 1988, disease severity should increase.

Regional Notes

Region 1: Large, sawlog size red pine in urban areas continue to die from this disease. Particularly hardhit areas are close to Park Rapids, but there are two areas around Bemidji which have also experienced mortality from this disease. It is thought that the urban stresses, particularly soil disturbances, predispose the trees to successful infections of this fungus.

Region 2: Understory saplings of red pine in St. Louis County showed some shoot infections.

Region 3: On a 40-acre private tract in Benton County greater than 90% of the trees were infected, and 25% of the trees were dead. Infections must have been going on for at least 1 to 2 years to cause mortality. No control action is planned.

At the General Andrews State Nursery, 2-0 red pine seedlings were found to be infected with Diplodia shoot blight. White pine were also found infected with this disease, and the infected white pine were also damaged by sunscald.

AMERICAN SPRUCE-RASPBERRY RUST
Pucciniastrum americanum (Farl.) Arth.

ACREAGE: 10

SEVERITY: Very low: 1.7% of cones were rusted.

RECENT HISTORY: The incidence and severity of cone pests have been monitored for the past several years at the White Spruce Seed Orchard, Cotton, St. Louis Co. A bumper cone crop was produced in 1984 and since that time, poor cone crops have been produced. Cone rust incidence in 1985 was 5%, and in 1986 it was 43%.

PREDICTIONS: A good to excellent cone crop next year is anticipated, and this should increase the incidence of this cone rust if weather conditions are favorable for disease dissemination and initiation.

Regional Notes

Region 2 Total cone production in the seed orchard was probably no more than 400-500 cones. 279 cones were collected, dissected, and rated for pest incidence. Only 1.7% of the cones were rusted; however, the cone crop was a 98.9% loss due to non-pollination. No Chrysomyxa pirolata cone rust was found.

Three field studies are reported in the Special Projects section of this report.

JACK PINE GALL RUST
Cronartium quercuum banksianae (Berk) Miyabe ex Shirai Fsp.
and
Endocronartium harknessii (JP Moore) Y.Hirats

ACREAGE: 2-0 beds at Badoura State Nursery

SEVERITY: 21% of 2-0 jack pines are infected.

RECENT HISTORY: This is an endemic diease throughout the jack pine range. It has also been an important problem in state nursery production of seedlings.

PREDCITION: None

PINE NEEDLE RUST
Coleosporium asterum (Dietel) Sydow

ACREAGE: Not determined; widespread on young plantations in Region 2.

SEVERITY: Heavy: >50% needles rusted

RECENT HISTORY: An endemic problem with increased incidence in years having favorable weather (wet and rainy) during the infection period in autumn of the previous year.

PREDICTION: Low to moderate rust based on dry fall weather patterns in 1987.

Phenological notes

April 15: Red pine buds starting to elongate: Side Lake, St. Louis Co.

May 18: Pustules abundant on red and jack pines: Duluth, St. Louis Co.; and Link Lake, Itasca Co.

June 1: Jack pine progeny test, 98% infected; trees are 3-6' tall: Nickerson, Pine Co.

June 5: Pustules abundant: Cloquet, Carlton Co.

WHITE PINE NEEDLECAST
Unknown

ACREAGE: Not determined; the areas of affected trees were in Itasca and southern Beltrami Counties.

SEVERITY: This disease occurred on large, old growth white pine and caused casting of second and third year needles during the spring. Infections occurred on the lower 2/3rds to 1/2 of the crown, and often 100% of the older needles on the bottom portions of the trees were cast. There were no direct losses to the trees, but infections did thin out the foliage and result in problems related to aesthetics.

RECENT HISTORY: Unknown; this is the first year needle loss on white pine was observed. The disease may have been present in prior years, but the wet conditions of 1986 may have allowed the disease to build up.

PREDICTION: This needlecast should be less in 1988 since disease occurence and severity are closely related to wet weather. Generally, 1987 has been a dry year, and conditions were not good for additional infections to occur. Landowners most concerned with this disease raked and burned the falled needles. This should help reduce the innoculum on a local basis.

NEEDLECASTS OF BALSAM FIR
Ishmiella faullii (Darker) Darker
and
Lirula nervata (Darker) Darker

ACREAGE: Not determined

SEVERITY: One Christmas tree plantation was rated. The incidence and severity of needle casts on 2-year old needles on 49 trees were as follows:

Percent infection	# of trees affected
0	6
trace	16
2-10	15
> 10	12

RECENT HISTORY: These diseases are endemic in forest stands, but locally have been a problem in Christmas tree plantations in northern St. Louis Co.

PREDICTION: Reinfection of already affected trees should occur during 1987 and be evident during 1988.

SPRUCE DECLINE
Unknown

ACREAGE: None determined; this problem has been observed primarily in windbreaks, shelterbreaks, and yard plantings in northwestern Minnesota Because of its sporadic occurrence, acreage determination is nearly impossible. Spruce decline has been found in Kittson, Marshall, Roseau, Lake of the Woods, and Beltrami Counties.

SEVERITY: Tree mortality occurs within 1 to 3 years after the beginning of symptoms.

RECENT HISTORY: This condition was first noticed in 1983 in Roseau and Kittson Counties. Symptoms are very similar to Rhizosphaera needlecast, but no fungal fruiting bodies can be found. The decline mainly occurs on white spruce, but blue spruce growing among white spruce are usually infected with Rhizosphaera needlecast. White spruce trees most heavily infected are trees which have been in the ground at least 15 years.

PREDICTION: It is unknown what the future holds for this decline and white spruce growing in the farm country in northwestern Minnesota. Currently, pathologists from the U.S. Forest Service, State and Private Forestry are studying this decline. Collections have been made, and fungi have been isolated from affected needles. Rhizospaera kalkofii, however, has not been identified. Efforts will be made in 1988 to identify the fungi isolated from the needles.

OAK WILT
Ceratocystis fagacerum (Bretz). Hunt

ACREAGE: East central Minnesota: unknown
Southeastern Minnesota: 200-300 acres in 130 to 140 oak mortality centers.

SEVERITY: The incidence of oak wilt disease in southeastern Minnesota within the hardwood forests is low. Within this region, the incidence increases to moderate and high on a few sandy soil types where disturbance is associated with urban development. In the four county Metro area north of Minneapolis and St. Paul, and further north in central Minnesota, there are thousands of pockets of infected and dead oaks on private lands concentrated in urban areas causing a severe impact on real estate values.

RECENT HISTORY: Oak wilt has been present in Minnesota for many years. Incidence of the disease seems to be on the increase, and this may be due to the greater utilization of the woodlands for housing development.

PREDICTION: This disease should continue to increase in incidence with increased tree mortality particularly in urban areas.

Regional Notes

Region 3: Two pockets on 8 acres were identified on state-owned commercial forest land in this Region. It was estimated that $2,000 worth of stumpage was lost in these pockets. The pockets were clearcut and the stumps treated in an effort to contain the spread of the disease within these pockets.

Region 5: In 1987, a two year project began to survey the occurrence of oak wilt disease in the state. In the first year, aerial sketch mapping was used to survey five counties in southeastern Minnesota. Color infrared photography was used to survey thirteen townships in the four country metro area. In 1988, another twenty-eight townships in the metro area will be photographed with sketch mapping completed in the remaining areas of survey.

OAK DECLINE
Various biotic and abiotic agents

ACREAGE: 7,000

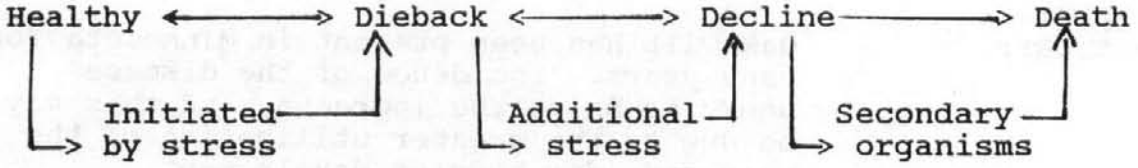
SEVERITY: Top dieback and tree mortality

RECENT HISTORY: Oak decline was first observed in 1985 in central Itasca County.

PREDICTION: Continued symptom expression and mortality is expected in affected trees. Some trees may recover and rebuild their crowns if they can ward off the attack by Armillaria root rot.

Regional Notes:

Region 2: Proposed disease etiology:



Healthy trees began to show dieback symptoms due to root starch depletion from stresses such as:

* Oaks growing on the north edge of their natural range; and
* Two years of heavy defoliation by the fall defoliator complex in 1982 and 1983.

Additional stresses on the photosynthetic capacity of the crown caused depletion of root starches and decline symptoms developed from:

* Winter bud kill in 1984;
* Heavy anthracnose in the spring of 1985.

Declining trees were then attacked by secondary organisms:

* Armillaria root rot successfully invaded major roots and girdled the trees. Armillaria mushrooms were extremely abundant on live, dying, and dead oaks in 1986 and 1987.

Many trees could not recover and died. Additional trees will likely die.

RED OAK TWIG CANKER
Dothiorella quercina (Cke. & Ell.) Sacc.

ACREAGE: 20,000

SEVERITY: Light to moderate

RECENT HISTORY: Unknown

PREDICTION: Unknown, but disease incidence is related to weather conditions.

Regional Notes

Region 5: In August, this disease was evident on red oak in Wabasha and Olmsted Counties. The lesions caused by the fungus developed in mid-summer and killed segments of twigs or small branches causing wilting and browning of fully expanded leaves. This flagging is very similar to symptoms caused by oak twig pruners and periodic cicadas. The cankers and flagging caused by this disease tend to occur in conspicuous outbreaks that subside after one or more years.

WILLOW BLIGHT
Pollaccia saliciperda (Allesch. & Tub.) Arx
and
Glomerella cingulata (Ston.)

ACREAGE: Not determined

SEVERITY: Very low

RECENT HISTORY: For the past several years in northeastern counties, willows have been blighted and then have died back due to moderate to high infection levels.

PREDICTION: None; will depend on weather conditions.

Regional Notes (Willow Blight)

Region 2: It is very likely that the dry spring played a major role in the large reduction in the amount of willow blight in Region 2 this year. Very little current year infection of either fungus was observed. Many of the trees which had high infection levels the past 2 years have high levels of branch mortality. Resprouting on the main stem was very common and trees began to recover in 1987.

Phenological notes

April 29: Willow catkins are spent: St. Louis Co.
June 17: Light infection noted in upper crown and epicormic shoots: Cotton, St. Louis Co.

WINTER INJURY

ACREAGE: Not determined

SEVERITY: Severe and extensive across southern Minnesota

RECENT HISTORY: In most years there is some minor winter burn of conifer species.

PREDICTION: It is not expected that this much extensive damage will be experienced again during 1988. However, during winters with extremely mild temperatures, greatly fluctuating temperature, and/or little snowfall, winter injury will again be serious.

Regional Notes

Region 5: The damage was extensive in young arborvitae species; Juniper species; red (Norway), white, and Scots pine; blue spruce; and balsam fir. Many thousands of arborvitae and juniper shrubs were completely or partially killed.

Young red pine were extensively top killed, and many balsam fir were top killed or completely died. The pines and fir began to fade in color in early April and were completely brown by May 1st. Spruce appeared unaffected until they shed their needles suddenly in late April.

Injured trees could be found adjacent to unaffected trees of the same species. The only recovery occurred in arborvitae; some plants began partial resprouting in late May.

The damage is attributed to winter drying which can occur when portions of or entire plants begin to transpire. On frozen ground, the lost moisture cannot be replaced.

FROST

ACREAGE:	Not determined, but white spruce and balsam fir were affected in Cook, Lake, and St. Louis Co.
SEVERITY:	Ranged from insignificant to 100% affected. In many cases all of the new shoots were killed during a late frost during the first week of June.
RECENT HISTORY:	Sporadic spring frosts .
PREDICTION:	Unknown

Regional Notes

Region 2: Balsam fir and white spruce in all size classes were particularly hard hit by a late frost. Most of Region 2, from Hibbing north to the border and east to the North Shore, was affected. The balsam shoots had elongated 1/2"-1" when they were killed. As the dead shoots dried, they resembled spruce budworm-killed shoots in both position and color.

MINOR AND INCIDENTAL PESTS

CONIFER DISEASES

Pest	Host	County	Comments
NEEDLECASTS			
Rhizosphaera kalkhoffi & *Lophomerum darkeri*	White spruce	Stearns	St. Cloud
Rhizosphaera kalkhoffi	Blue spruce	Statewide	Common homeowner problem
Lirula macrospora	White & blue spruce	Beltrami	Heavy infections on a lakeshore property
Leptostroma sp.	Red pine	Hubbard	
Ishmiella crepidiformis	Black spruce	St. Louis	
BLIGHT			
Pestalotia sp.	Red cedar	Crow Wing	
Phomopsis sp.	Red cedar	Pine	General Andrews State Nursery
TIP BLIGHT			
Sirococcus strobilinus	Red pine	St. Louis	Understory saplings
CANKER			
Cytospora kunzeii	White spruce	Kooch.	
ROOT ROT			
Armillaria spp.	Jack pine	Beltrami	Urban tree mortality

HARDWOOD DISEASES

Pest	Host	County	Comments
ANTHRACNOSE			
Apiognomonia sp.	Oaks	Lake	
Unknown	Bur oak	Becker	
Anthracnose Various fungi	Ash, maple oak	Southern Minnesota	Light occurrence
OTHER FOLIAGE DISEASES			
Frogeye spot *Physalospora* sp.	Apple	Itasca	Spring infection
VASCULAR WILTS			
Dutch elm disease *Ceratocystis ulmi*	Elm	Southern Minnesota	Continues at endemic levels
BLIGHTS			
Chestnut blight *Endothia parasitica*	American chestnut	Olmstead	Hypovirulence introduced for control
TWIG INHABITORS			
Cornularia sp.	Pin cherry	Itasca	
Dactylsporium sp.	Maple	Ottertail	Saprophyte
Cytospora annulata	Boxelder	Douglas	Associated with cankers
ROOT ROT			
Fusarium spp.	Black walnut	Pine	General Andrews State Nursery on potted 1-0 stock
Armillaria spp.	Sugar maple	Olmstead	Urban tree mortality
OTHER			
Aspen bronzing	Bigtooth aspen	Beltrami	Symptoms first showed on July 17

ABIOTIC DISEASES

Pest	Host	County	Comments
WEATHER			
Winter injury	Red oak	Pine	General Andrews State Nursery
Winter injury	White cedar	Hubbard	Badoura State Nursery
Frost	Apple	Itasca	
Wind	Red pine, aspen, white spruce	Beltrami,	Severe damage from two summer storms
Lightning	White pine	Beltrami	
Sunscald	White pine	Itasca	Containerized seedlings
High water table	Red & jack pines	St. Louis, LOW, Becker, Hubbard, Wadena Crow Wing	Around potholes
Drought	White spruce	St. Louis	
NON-WEATHER			
Mechanical injury	White spruce	Kooch.	3-0 seedlings
Fertilizer damage	Red pine	Carlton	Nursery
Herbicide 2,4-D	Red oak	Pine	Carry over in soil at General Andrews State Nursery
Planting shock	Red maple	Beltrami	Homeowner

ANIMAL DAMAGE

Post	Host	County	Comments
Red squirrels	White spruce	Beltrami, Itasca	Nipped ends of twigs to eat flower buds; widespread
Deer	White pine	Becker	Christmas tree plantation
Sapsuckers	Bur oak	LOW	Homeowner problem

MINOR AND INCIDENTAL PESTS

CONIFER INSECTS

Pest	Host	County	Comments
Redheaded pine sawfly *Neodiprion lecontei*	Jack pine	Itasca	Seed orchard
White pine sawfly *Neodiprion pinetum*	White pine	Olmstead	Urban
Pitch nodule maker *Petrova albicapitana*	Jack pine	Todd, Itasca	Seed orchard
White pine weevil *Pissodes strobi*	Red pine	St.Louis	
Spruce gall aphid *Adelges abietis*	White spruce	St. Louis LOW	

CONIFER INSECTS (CONTINUED)

PEST	HOST	COUNTY	COMMENTS
Pine bark adelgid *Pineus strobi*	White pine	Hubbard	
Pine needle scale *Phenacaspis pinifoliae*	White pine	Beltrami Roseau Marshall LOW	Heavy infestation to ornamentals and shelterbelt trees
Spider mites *Oligonychus ununguis*	White spruce	Douglas	Heavy during hot, dry weaather
Wooly aphids Unknown	Red pine	Itasca	
Aphids Unknown	Jack pine	Beltrami	Heavy infestation in jack pine progeny test block
Bark beetles *Dendroctonus simplex*	Tamarack	Marshall	Heavy infestation in a 40-acre tract near Newfolden
Sawyer beetle *Monochamus* sp.	Balsam fir	St.Louis	Twig feeding

HARDWOOD INSECTS

Pest	Host	County	Comments
Spring cankerworm *Paleacrita vernata*	Aspen Elm, Bur oak	Roseau Kittson Marshall Pennington Red Lake Polk	Causing spotty, but noticeable defoliation in the farm country in NW Minnesota
Fall webworm *Hyphantria cunea*	Hardwoods	Winona	Light

HARDWOOD INSECTS (CONTINUED)

PEST	HOST	COUNTY	COMMENTS
Eastern tent caterpillar *Malacosoma americanum*	Hardwoods	Southern Minnesota	Moderate to heavy infestation
Mourningcloak butterfly *Nymphalis antiopa*	Chinese elm	Hubbard	Homeowner
Metallic beetle *Anametis granulata*	Horse chestnut	Itasca	Caused defoliation
Mountain ash sawfly *Pristophora geniculata*	Mountain ash	Beltrami Clearwater	Heavy feeding on ornamental trees in the Bemidji and Bagley areas
Maple leafroller *Cenopis acerivorana*	Maple	St. Louis	
Defoliator Unknown	Basswood	Douglas Hubbard	Caused heavy defoliation in mid to late summer
Birch leaf-miner *Fenusa pusilla*	Birch	Olmstead	Heavy infestation to urban trees
Leafminer Unknown	Balsam poplar	Cass	Locally heavy
Gall Midge *Cecidomyidae* sp.	Pin cherry	Itasca	In twig axils
Red pouch gall aphid *Rhois* sp.	Sumac	Itasca	

HARDWOOD INSECTS (CONTINUED)

Pest	Host	County	Comments
Gall mites *Vasates quadripedes* *V. aceriscrumena*	Maple	Beltrami LOW Hubbard	Locally heavy
Poplar borer *Saperda calcarata*	Aspen	Itasca	
Bark beetles Unknown	Bur oak	Itasca	Top kill

MISCELLANEOUS INSECTS

Pest	Host	County	Comments
Antlion *Dendroleon sp.*	None	Itasca	
Powder Post beetles Unknown	Cabin logs	Hubbard	New infestations to old log homes

SPECIAL PROJECTS

White Spruce Seed Orchard Studies

By Mike Albers and Jana Campbell

Study # 1

A study was set up using pheromone-baited sticky traps to attract Dioryctria abietivorella (Grote) in order to ascertain the time of moth flight in Minnesota and test the efficacy of several pheromone formulations. This study was done in cooperation with Dr. Gary Grant, FPMI, Sault Ste. Marie, who supplied the pheromones.

The study was located at the DNR, Div. of Forestry Seed Orchard near Cotton, Mn and at the Potlach Corp. Seed Orchard near Cloquet, Mn. At Cotton, 4 different synthetic pheromone formulations plus the natural female pheromone and a control were tested in a randomized block design with 4 replications. At Cloquet, 4 synthetic pheromone formulations plus the natural female pheromone and a control were tested in a randomized block design with 2 replications. In all, 6 different synthetic pheromones and the natural female pheromone were tested.

Traps were placed in the seed orchards on April 29, just prior to pollen shed which started May 1st. Traps were checked every 7-10 days for moths during May, June and July.

RESULTS

No Dioryctria moths were trapped at either site. Traps were not set out in August and September, as planned. Dr. Grant did not obtain good trapping results this year in his other trapping studies and suggested that the pheromones and formulations were to blame. Also, as will be seen in the results of Study # 3, the population of Dioryctria was extremely low at the Seed Orchard in Cotton this year. No Dioryctria damaged cones were found.

Study # 2

A study was set up to test the effectiveness of using chlorothalonil (Bravo 500) to protect female cones from cone rust infection at the White Spruce Seed Orchard near Cotton, Mn. This seed orchard in the past has suffered heavy losses from the cone rust fungi, Pucciniastrum americanum (Farl.) Arth. and Chrysomyxa pirolata Wint.

The cone crop at the orchard was very poor and most trees did not produce any cones in 1987. For this study, a clone was selected only if it contained at least 3 ramets which each had a minimum of 10 female cones. This was done so that one of the ramets from each clone could serve as the control and the other 2 ramets could be treated. A total of 18 trees were included in this study. Six trees served as controls. Another 6 trees were sprayed on 4 dates: May 1, 8, 15, and 21. The remaining 6 trees were sprayed on 5 dates: May 1, 8, 15, 21, and 29. Trees were sprayed to the point of runoff with Bravo 500 at 57 mls per 1.5 gallons of water. The clones included in the study and the number of trees per clone are listed below:

Clone	Trees
4001	3
4003	3
4009	3
4016	9

RESULTS

Very little rust infection was found at the Cotton seed orchard in 1987. Of 279 cones examined in this study, only 5 cones (1.7%) were infected with rust. Only Pucciniastrum americanum was found. Results are shown below:

Treatment	# Infected cones	Clone
Control	1	4003
	3	4016
Sprayed 4 times	1	4016
Sprayed 5 times	0	----

Due to the extremely light level of cone rust infection at the seed orchard, no conclusions can be drawn about the effectiveness of chlorothalonil in protecting cones against rust infection. Using a paired t-test, there was no significant difference between the control and the sprayed trees at the .05 level.

Study # 3

In this study, insect and disease damage to white spruce cones was monitored and evaluated. The trees and cones used in this study were those used in Study # 2 . They were used primarily because they were about the only trees in the seed orchard with enough cones per ramet to evaluate. 279 cones were collected and brought into the lab for examination. The exterior of each cone was examined for the presence of insects, diseases, and other problems. The cones were then cut in half longitudinally using a cone cutter and the cut surfaces were examined. The insect and/or disease which caused the damage was identified where possible.

RESULTS

Most of the insect damage was caused by spruce budworm larvae, Choristoneura fumiferana (Clemens), and by the spruce cone maggot, Hylemya anthracina (Czerny). The only cone rust found in the dissected cones and in the seed orchard in 1987 was Pucciniastrum americanum (Farl) Arth. Most of the cones contained shrivelled, dry seed which may have been a result of frost damaging the conelet during pollination or a result of insufficient pollination. Often, all but 1 or 2 of the seeds in a cone were in this condition. There was no significant difference in insect damage between the controls and the fungicide treated cones so the data were all combined in the table below. Percent damage figures are not additive since cones could be damaged by more than 1 agent.

Agent or condition	Percent cones damaged
Insects	8.9
Rust	1.7
Shrivelled,dry seeds	98.9

Only 3 cones out of 279 were not damaged and produced 100% viable seed.

INSECT AND DISEASE TRAINING

An insect and disease training course entitled, "An Introduction to Minnesota's Forest Insects and Diseases", was devloped by the Insect and Disease Management Unit staff. The course was aimed at Division of Forestry personnel with the objective of eventually requiring all personnel to attend the course.

The first session was conducted at the Cloquet Forestry Center on August 10 - 12. Forty-five foresters and technicians from throughout the state attended. The attendees at this first session were those who were identified as having a strong interest and/or could serve as a lead worker in forest insects and disease work in their respective administrative areas.

The session consisted of 18 contact hours with the instructors plus approximately 8 to 12 hours of prework assignments carried out over a period of 4 weeks. There were 4 prework assignments with each assignment containing a test which had to be completed before the next prework assignment was sent out. Anyone not completing the prework was not allowed to attend the session.

Classroom lectures, hands-on lab exercises, tests, and a final field problem formed the basis for the course. The session began with a discussion on the concepts of disease and damage. An introductory session on micro and macroorganisms with a hands-on laboratory session then followed. The second day included a lecture on abiotic diseases and a lengthy session and exercise on diagnosing insect and disease problems. This was followed by an introduction to the principles of pest management, and the day was capped off with a field problem in which small groups had to identify the damage and outline a course of action to mitigate the damage immediately and over the length of a rotation.

The third day began with a presentation made by each of the small groups outlining their diagnoses and solutions to the field exercises. This was followed by a discussion on Minnesota's pest management guidelines, hardwood pest management, and an introduction to hazard tree recognition and management. The course ended with a final exam.

Course critiques were very positive. The combination of lectures, discussions, field problems, and hands-on activities helped make the session "palatable" and helped make the information retainable. Session success was evidenced by informal follow-ups in the field in which there was a noticeable change in attendees' attitudes and interest in more critically looking at insect and disease situations

on their home turf. Because of the complexities of insects and diseases, the course was not designed to make experts out of the personnel attending. However, the chief objective was to heighten awareness so that insect and disease management principles can be better integrated into the routine forest management activities. Informal follow-up seemed to indicate that his objective was met by this session.

The course will be repeated in August, 1988 and expanded to two sessions. This will permit an offering of the training to counties and other agencies.

APPENDICES: SURVEY RESULTS

-JACK PINE BUDWORM-

REGION 1

COUNTY	DESCRIPTION	NO. SHOOTS W/ LARVAE	DEFOLIATION PREDICTED	DEFOLIATION ACTUAL
BECKER	02-139-36	4	L	M
	04-139-36	4	L	M
	14-139-36	0	0	M
	14-139-36	0	0	M
	15-139-36	1	VL	M
	22-139-36	0	0	L
	23-139-36	1	VL	L
	26-139-36	5	L	VL
	28-140-36	3	L	M
	34-140-36	3	L	H
	20-141-36	4	L	L
	27-141-36	10	L	H
	33-141-36	6	L	L
	34-141-36	6	L	M
	25-142-36	7	L	VL
BELTRAMI	18-146-32	0	0	0
	34-146-32	1	L	0
	16-146-35	7	L	H
	21-146-35	8	L	H
	22-146-35	5	L	H
	23-146-35	7	L	H
	24-146-35	5	L	L
	35-146-35	7	L	M
	04-147-34	7	L	H
	06-147-34	4	L	M
	08-147-34	6	L	H
	10-147-34	1	VL	M
	11-147-34	3	L	M
	13-147-34	0	0	L
	19-147-34	5	L	H
	26-147-34	0	0	VL
	30-147-34	0	0	H
	36-147-34	0	0	VL
	02-147-35	3	L	H
	03-147-35	0	0	H
	04-147-35	0	0	H
	11-147-35	3	L	H
	13-147-35	3	L	H
	36-147-35	2	VL	L
	19-148-35	3	L	VL
	28-148-35	10	L	H
	29-148-35	10	L	H
	31-148-35	4	L	L

COUNTY	DESCRIPTION	NO. SHOOTS W/ LARVAE	DEFOLIATION PREDICTED	ACTUAL
BELTRAMI	31-148-35	1	VL	L
	33-148-35	5	L	M
CLEARWATER	07-145-38	0	0	0
	17-148-38	0	0	0
	20-145-38	1	VL	0
	30-145-38	0	0	0
HUBBARD	06-139-32	2	VL	L
	09-139-32	1	VL	VL
	10-139-32	0	0	0
	11-139-32	0	0	0
	11-139-32	1	VL	0
	19-139-32	0	0	L
	25-139-32	0	0	0
	25-139-32	1	VL	0
	17-139-34	0	O	L
	30-139-34	1	VL	VL
	31-139-34	2	VL	VL
	19-139-35	5	L	L
	35-139-35	1	VL	L
	23-140-32	1	VL	VL
	30-140-32	1	VL	L
	30-140-32	1	VL	M
	34-140-32	0	0	L
	36-140-32	0	0	0
	22-140-33	0	0	M
	35-140-33	3	L	L
	12-143-33	9	L	H
	24-143-33	1	VL	VL
	03-143-34	3	L	M
	04-143-34	14	M	L
	04-143-34	4	L	L
	06-143-34	2	L	L
	09-143-34	6	L	L
	10-143-34	8	L	H
	16-143-34	14	M	H
	10-144-34	10	L	L
	22-144-34	11	M	H
	27-144-34	8	L	M
	27-144-34	10	L	M
	32-144-34	7	L	H
	34-144-34	5	L	L
	03-145-32	0	0	0
LAKE OF THE WOODS	02-158-34	0	0	0
	13-159-33	0	0	0
	27-159-33	0	0	0
	29-159-33	2	VL	0
	30-159-33	1	VL	0
	34-159-33	3	L	0

COUNTY	DESCRIPTION	NO. SHOOTS W/ LARVAE	DEFOLIATION PREDICTED	ACTUAL
LAKE OF THE WOODS	35-159-33	1	VL	0
	11-159-34	0	0	0
	13-159-34	0	0	0
	15-159-34	0	0	0
	01-159-35	0	0	0
	07-159-35	1	VL	0
	08-159-35	0	0	0
	15-159-35	1	VL	0
	17-159-35	0	0	0
	24-159-35	0	0	0
	14-159-36	0	0	0
	20-159-36	0	0	0
MAHNOMEN	02-145-39	0	0	0
	11-145-39	0	0	0
	35-146-39	0	0	0
	35-146-39	0	0	0
ROSEAU	09-159-37	0	0	0
	11-159-37	0	0	0
	06-159-38	0	0	0
	01-160-37	0	0	0
	04-160-37	0	0	0
	06-160-37	0	0	0
	18-160-37	1	VL	0
	30-160-37	0	0	0
	26-160-38	0	0	0
	34-160-38	1	VL	0
	36-160-38	0	0	0
	34-161-35	0	0	0
	19-161-36	0	0	0
	20-161-36	0	0	0
	25-161-36	0	0	0
	27-161-36	2	VL	0
	29-161-36	0	0	0
	30-161-36	0	0	0
	31-161-36	0	0	0
	25-161-37	0	0	0
	26-161-37	0	0	0
	33-161-37	0	0	0
	34-161-37	1	VL	0

REGION 2

1987 JACK PINE BUDWORM PHEROMONE TRAPPING RESULTS

PLOT LOCATION	TOTAL TRAP CATCHES (# MOTHS)	1987 DEFOLIATION
KOOCHICHING CO.		
4-65-24	3	Very Light
ST. LOUIS CO.		
30-67-17	1	Very Light
14-65-14	6	Very Light
36-61-13	3	None
24-64-13	8	Light
23-60-21	0	None
35-58-15	1	None - VL
09-57-16	1	None - VL
ITASCA CO.		
27-59-23	0	None
COOK CO.		
16-65-4W	4	Light
23-62-4W	0	None
LAKE CO.		
16-63-9	5	Light

REGION 3

1987 JACK PINE BUDWORM PHEROMONE TRAPPING RESULTS

PLOT NAME	COUNTY	PLOT LOCATION	NO. MOTHS	EGGS	DEFOLIATION
Nursery	Pine	24-45-20	1	0	Light
Willow River	Pine	36-45-20	35	1	Light
Brainerd	Crow Wing	16-144-31	69	0	Light
Pequot Lakes	Crow Wing	11-136-29	13	0	Light
Nimrod	Wadena	20-138-33	47	0	Light
Huntersville	Wadena	19-138-33	11	0	Light
Shell River	Wadena	2-138-34	56	0	Light
Menahga	Wadena	18-138-24	50	0	Light
McKinley	Cass	15-138-32	487	0	Moderate

-PINE TUSSOCK MOTH-

REGION 3

TRAP LOCATION	DATE	# MOTHS
CROW WING CO.		
NWSE 9-136-27	7-15	10
	7-27	20
	8- 7	9
	8-14	3
NWSW 9-136-27	7-15	10
	7-27	14
	8- 7	BIRD
	8-14	2
SENE 10-136-27	7-15	17
	7-27	28
	8- 7	21
	8-14	20
NENE 23-136-27	7-15	6
	7-27	13
	8- 7	3
	8-14	1
PINE CO.		
SWNW 6-44-19	7-13	12
	7-21	17
	8- 5	13
	8-13	0
SENE 6-44-19	7-13	15
	7-21	25
	8- 5	9
	8-13	0
NESE 13-45-20	7-13	12
	7-21	16
	8- 5	14
	8-13	1
SESW 25-45-20	7-13	10
	7-21	24
	8- 5	5
	8-13	0

REGION 3 PINE TUSSOCK MOTH TRAPPING RESULTS (CONTINUED)

TRAP LOCATION	DATE	# MOTHS
PINE CO.		
SWNE 25-45	7-13	8
	7-21	8
	8- 5	7
	8-13	0
NWSE 30-45-19	7-13	13
	7-21	18
	8- 5	7
	8-13	2

REGION 2

1987 SPRUCE BUDWORM PHEROMONE TRAPPING RESULTS

PLOT LOCATION	# MOTHS	1987 DEFOLIATION	1987 # LARVAE	1987 EGGMASSES
CARLTON				
12-49-19	16	None	2	0
COOK				
32-64-3E	593	Heavy	1	X
11-63-4E	181	Moderate	28	X
32-54-3W	585	Heavy	9	X
25-61-4W	666	Heavy	5	4
1-61-1W	1,575	Heavy	7	X
LAKE				
36-59-11	164	Very Light	22	X
19-55-10	215	Moderate	23	6
36-52-12	1,125	Light	40	3
9-63- 9	1,874	Heavy	X	13
9-58- 6	128	None	0	0
St. Louis				
8-68-20	29	Very Light	16	7
1-68-20	184	Very Light	10	X
8-65-20	74	Light - VL	1	X
14-65-14	927	Light - M	3	X
16-65-17	2,076	Light	3	0
22-61-14	180	Light	X	X
24-64-13	1,481	Moderate	X	X
13-59-20	882	Moderate	X	X
4-59-21	1,350	Light - M	X	3
32-60-17	173	Light	X	3
18-53-17	562	Heavy	49	1
3-53-16	192	Moderate	7	0
14-52-16	173	Moderate	1	0
16-51-15	321	Light	5	0

DIVISION OF FORESTRY

ADMINISTRATIVE BOUNDARIES & OFFICE LOCATIONS